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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/885,319	06/19/2001	Mark A. Stan	1613370-0006	4594

7590 05/16/2002

Corporate Patent Counsel  
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EXAMINER

MUTSCHLER, BRIAN L

ART UNIT	PAPER NUMBER
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1753

DATE MAILED: 05/16/2002

6

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 09/885,319	<b>Applicant(s)</b> STAN ET AL.	
	<b>Examiner</b> Brian L. Mutschler	<b>Art Unit</b> 1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_\_.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-37 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-37 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 December 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☒ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All   b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)                      4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)                      5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_                      6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Priority***

1. The filing date of the Provisional Application No. 60/212,552 provided by the Applicant, June 19, 2000, does not match the filing date of record in the Office, June 20, 2000. The priority statement in the specification should be changed to reflect the correct filing date, June 20, 2000.

### ***Oath/Declaration***

2. The filing date of Provisional Application No. 60/212,552 provided in the Declaration does not match Office records. A new Declaration should be submitted with the correct filing date: June 20, 2000.

### ***Specification***

3. The disclosure is objected to because of the following informalities:
- a. On page 6 beginning at line 17, the "range from 0 to 1" does not elucidate the concentration of the InGaP. The sentence should be changed to clarify the description of the nucleation layer.

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 112***

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 2, 4, 8 and 11-37 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 2 at line 2, claim 11 at line 5 and claim 32 at line 2, the phrase "a lattice parameter substantially equal to the lattice parameter of the germanium substrate" is indefinite because the degree of variability of the term "substantially" has not been defined. The same applies to dependent claims 12-19 and 26.

In claims 4, 13, 23 and 34, all at line 2, the phrase "a thickness substantially equal to 350Å or less" is indefinite because the range encompassed by the term "substantially" has not been defined.

In claims 8, 16 and 37, all at line 2, the phrase "substantially between 0.3 μm and 0.7 μm" is indefinite because the range encompassed by the term "substantially" has not been defined.

In claim 12 at line 3, the phrase "indium gallium arsenide" does not match the chemical formula "InGaP". Since the use of indium gallium arsenide was not disclosed as nucleation layer, it was assumed that the phrase should have been "indium gallium phosphide".

In claim 20 at line 7 and in claim 31 at line 9, the phrase "diffusion...can be limited" renders the claim indefinite because it is not clear whether the diffusion is or is not limited in the claimed invention. It is suggested that the phrase be changed to "diffusion...is limited". The same applies to dependent claims 21-25, 27-30 and 32-37.

In claim 26 at lines 2 to 3, the phrase "two-step diffusion profile can be achieved" is indefinite because it is not clear whether the profile is or is not achieved. It is suggested that the phrase be changed to "two-step diffusion profile is achieved".

Claim 26 is indefinite because it is a method claim dependent from an apparatus claim (claim 19). It was assumed that claim 26 should be dependent from claim 20.

Claim 37 recites the limitation "the first cell layer" in lines 1-2. There is insufficient antecedent basis for this limitation in the claim. It was assumed that the limitation should have applied to the germanium substrate as in the embodiments described in previous claims.

### ***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

7. Claims 1-6, 8, 11-14, 16, 19-24, 27, 31-35 and 37 are rejected under 35 U.S.C. 102(e) as being anticipated by Ermer et al. (U.S. Pat. No. 6,380,601).

Ermer et al. disclose a multijunction solar cell having a germanium substrate **22** doped with an n-type dopant, a nucleation layer **34** comprised of indium gallium

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phosphide (InGaP), a second cell layer **36** of gallium arsenide (GaAs), and a third cell layer **44** of InGaP (col. 2, line 53 to col. 4, line 46). The nucleation layer **34** is formed at a preferred thickness of 25 Å to 500 Å and has a lattice parameter at a desired degree of lattice matching to the substrate **22** either "matched, or selectively made non-matching" (col. 3, lines 28-49). The solar cell of Ermer et al. would inherently absorb radiation ranging from UV radiation to a wavelength of 1800 nm through the use of Ge, GaAs and InGaP layers. Phosphorous is the preferred n-type dopant in the Ge substrate **22** (col. 3, line 1). The junction depth in the Ge substrate **22** ranges from 0.1 μm to 3 μm (col. 3, lines 7-10).

As subsequent layers are formed, the nucleation layer **34** would control the diffusion of dopant atoms into the substrate **22**. At the elevated temperatures at which the semiconductor layers are formed, solid state diffusion of dopants, such as arsenic from the GaAs layer **36**, would be controlled by the thickness of the nucleation layer **34**. Ermer et al. disclose "the invention allows for better passivation of the germanium homojunction substrate and shallower doping profiles with better control over diffused dopant concentrations" (col. 1, lines 63-66).

In addition to the method for forming the solar cell having the structure described above, Ermer et al. further disclose the use of metal-organic vapor phase epitaxy (MOVPE), which is also known as metal-organic chemical vapor deposition (MOCVD) (col. 4, line 67 to col. 5, line 1).

Since Ermer et al. teach all of the limitations recited in the instant claims, the reference is deemed to be anticipatory.

***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 7, 9, 10, 15, 17, 18, 25, 26 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ermer et al. (U.S. Pat. No. 6,380,601).

Ermer et al. disclose a method and apparatus having all of the limitations recited in claims 1-6, 8, 11-14, 16, 19-24, 27, 31-35 and 37, as explained above in paragraph 7. However, the method and apparatus of Ermer et al. differs from the instant invention because Ermer et al. does not disclose the following:

- a. The use of arsenic as the n-type dopant, as recited in claims 7, 15, 25 and 36;
- b. A two-step diffusion profile, as recited in claims 9, 17 and 26; and
- c. One sun AM0 efficiencies in excess of 26%, as recited in claims 10 and 18.

Regarding claims 7, 15, 25 and 36, Ermer et al. disclose that "the germanium is typically made by doping the surface region of the germanium substrate with arsenic" (col. 1, lines 34-35).



It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the solar cell of Ermer et al. to use arsenic as the n-type dopant because using arsenic is well known to those skilled in the art.

Regarding claims 9, 17 and 26, depending on the thickness of the nucleation layer **34** used in the solar cell of Ermer et al., a two-step diffusion profile could be formed. At the temperatures used for the deposition of the upper cell layers, solid state diffusion of arsenic would occur from the GaAs layer **36** to the substrate **22** if a thin nucleation layer **34** were used.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the solar cell of Ermer et al. to use a two-step diffusion profile because a two-step diffusion profile would add the benefits of a high thermal stability associated with deep junctions and the high efficiency associated with shallow junctions.

Regarding claims 10 and 18, the object of all solar cells made is to have the highest possible efficiency. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the solar cell of Ermer et al. to have the highest efficiency possible because maximizing the efficiency of solar cells uses the available energy in the best way possible.

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10. Claims 9, 17 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ermer et al. (U.S. Pat. No. 6,380,601) in view of Stanbery (U.S. Pat. No. 4,322,571).

Ermer et al. disclose a method and apparatus having all of the limitations recited in claims 1-6, 8, 11-14, 16, 19-24, 27, 31-35 and 37, as explained above in paragraph 7. However, the method and apparatus of Ermer et al. differs from the instant invention because Ermer et al. does not disclose the formation of a two-step diffusion profile in the substrate.

Stanbery discloses a method for forming a solar cell with a two-step diffusion profile. The solar cell has areas with a deep junction, which has a high thermal stability, an areas of shallow junctions, which have high light-to-electrical energy conversion efficiencies (col. 5, lines 64-68).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the solar cell of Ermer et al. to use a two-step diffusion profile as taught by Stanbery because the two-step diffusion profile has high thermal stability and a high conversion efficiency.

11. Claims 28, 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ermer et al. (U.S. Pat. No. 6,380,601) in view of Gibbons (U.S. Pat. No. 4,001,864).

Ermer et al. disclose a method and apparatus having all of the limitations recited in claims 1-6, 8, 11-14, 16, 19-24, 27, 31-35 and 37, as explained above in paragraph 7.

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However, the method and apparatus of Ermer et al. differs from the instant invention because Ermer et al. does not disclose the method or source of diffusion of dopant atoms into the substrate.

Regarding claims 28 and 29, at the temperatures used for the deposition of the upper cell layers, solid state diffusion of phosphorous atoms from the InGaP nucleation layer 34 to the substrate 22 would occur.

Gibbons discloses a method for fabricating solar cells wherein solid state diffusion is used to redistribute impurities to create efficient pn junctions (col. 10, line 13).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Ermer et al. to use solid state diffusion using the nucleation layer as the source of dopant atoms because Gibbons teaches that solid state diffusion can be used to redistribute dopant atoms and

Regarding claim 30, gas phase diffusion is a conventional technique for supplying a dopant to a semiconductor layer.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Ermer et al. to diffuse the dopant atoms by gas phase diffusion because gas phase diffusion is a common and efficient method for diffusing dopant atoms into semiconductor layers.

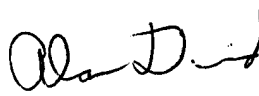
**Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (703) 305-0180. The examiner can normally be reached on Monday-Friday from 8:00am to 4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (703) 308-3322. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

blm  
May 13, 2002

  
**ALAN DIAMOND**  
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